

North Dakota Discovery Farms

Agricultural Monitoring in a Small Watershed

North Dakota Water Quality
Monitoring Conference
February 2012



Kathleen Rowland & Bill Damschen

Ron Wiederholt & Kevin Vining



Cooperators



...with support from ND's agricultural community

Origins of Discovery Farms

- Modeled after the Wisconsin Discovery Farms program which is similar to a program originally developed in the Netherlands
- Wisconsin agricultural leaders, producers, and university personnel made several trips to the Netherlands before starting a program in Wisconsin with the USGS
- In Wisconsin, it is a 3-part program: several **Discovery Farms**, one Pioneer Farm, and research component

Project Goals

- Monitor agricultural runoff from actual farm or ranch settings for **local (or small watershed)** environmental impacts
- If impacts exists, utilize best management practices (BMPs) to correct problem(s)
- Monitor success of BMPs and report

Description of North Dakota Project

- Project duration: FY 2007 – 2014
- 3 farms - cattle & crop; crop with drain tile for the initial farms – other farm types may be added for later study
- Event-based (snowmelt & precip) project
- 3 data collection shelters per farm
- Water quality / sediment / hydrologic / meteorological / soil moisture & temp
- Sampling season: March through October

Technology

Discovery Farms – Underwood Site Map



Base Station –
472731101175500
DISCOVERY FARMS
WATERWAY SITE 1 NEAR
UNDERWOOD, ND

Connect via phone modem to
communicate with all 3
dataloggers in network.

2 ft H Flume to compute flow.

All data is collected at 15
minute intervals for non-flowing
conditions and at 5 minute
intervals for flowing/event
conditions.

Telephone number is XXX-
XXX-XXXX

COM220
CR1000
RF401

Sensors-
Stage
Computed Flow
Shelter Interior
Temperature
Refrigerated Sampler
Temperature



472727101175000 DISCOVERY
FARMS WATERWAY SITE 2 NEAR
UNDERWOOD, ND

Connect via RF401 radio link to base
station

2 ft H Flume to compute flow.

RF401
CR1000

Sensors-
Stage
Computed Flow
Air Temp/RH
Precipitation
Soil Moisture
Wind Speed and Direction
Soil Temperature
Shelter Interior
Temperature
Refrigerated Sampler
Temperature



472709101175100 DISCOVERY
FARMS WATERWAY SITE 3 NEAR
UNDERWOOD, ND

Connect via RF401 radio link to base
station

2 ft H Flume to compute flow.

RF401
CR1000

Sensors-
Stage
Computed Flow
Shelter Interior
Temperature
Refrigerated Sampler
Temperature



Using wireless
technology to
program samplers and
retrieve data remotely

Flumes



2.0 foot H-flume for
surface-water runoff –
maximum flow
capacity of 11.0 cfs

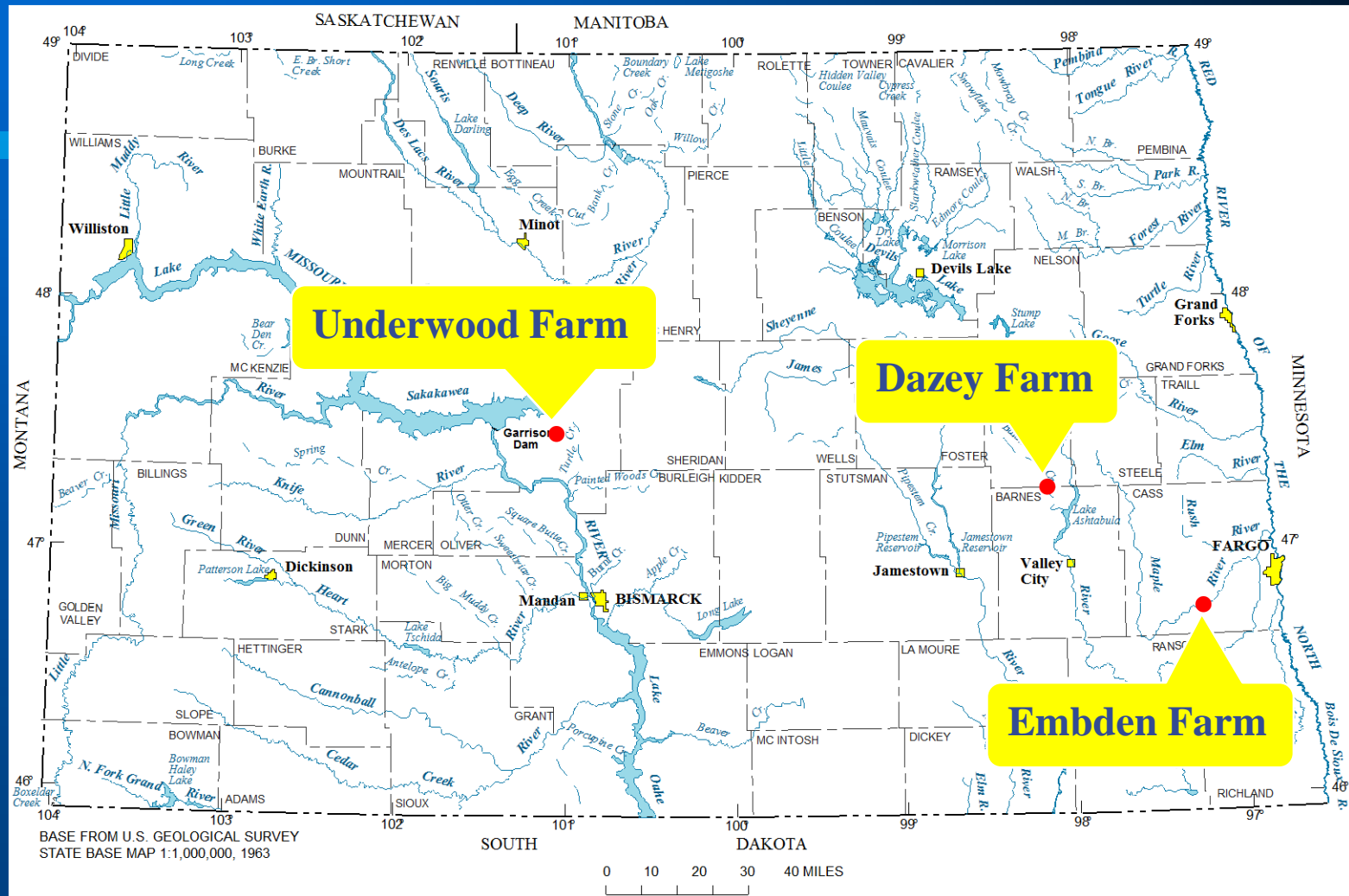
Embden Flume



60-degree V trapezoidal
flume for groundwater
runoff -----maximum
flow capacity of 1.5 cfs



Farms Locations



Underwood

- Drainage area about 2.5 mi²
- Drains to Missouri River (about 5 mi west)



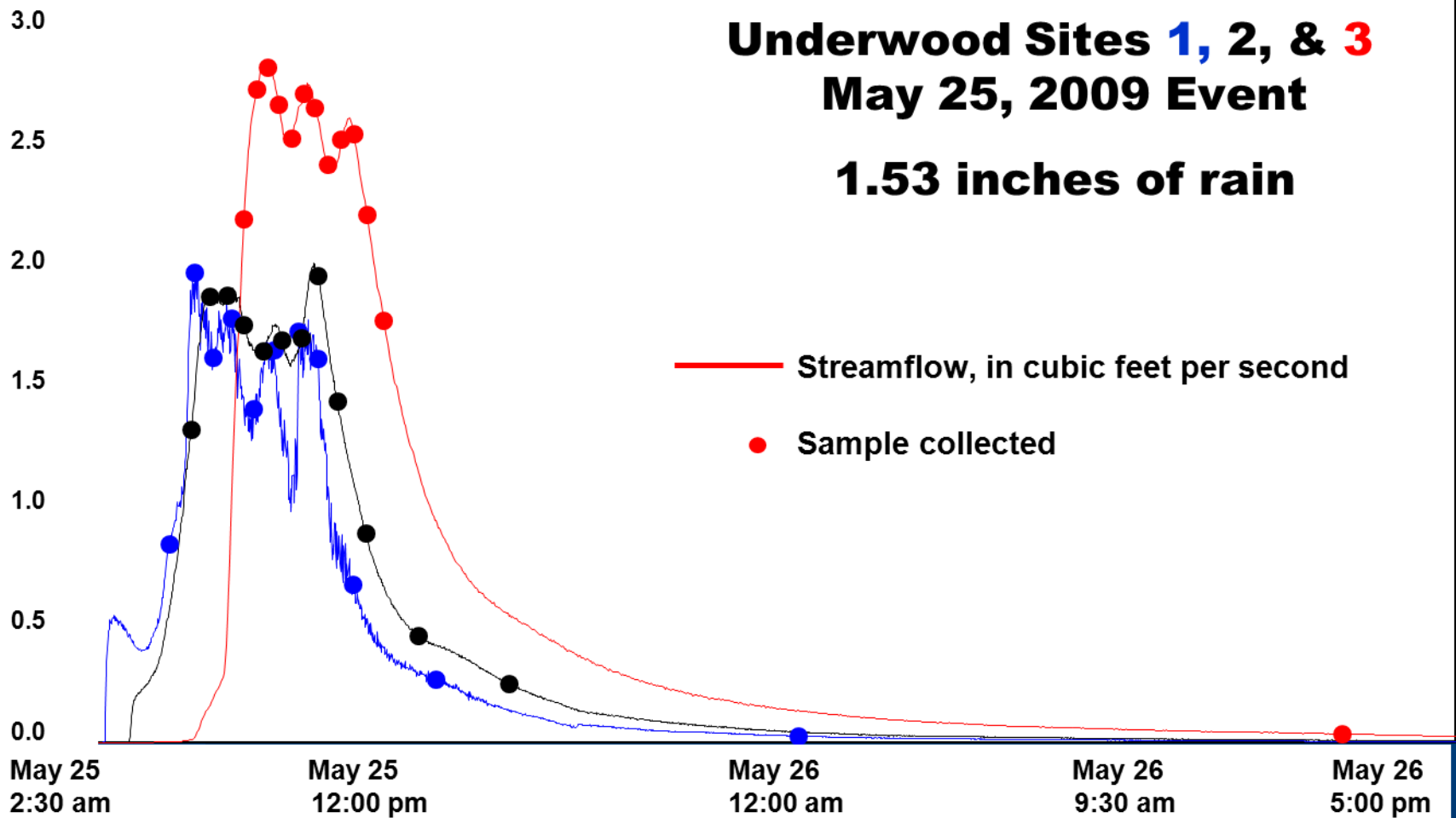
Underwood



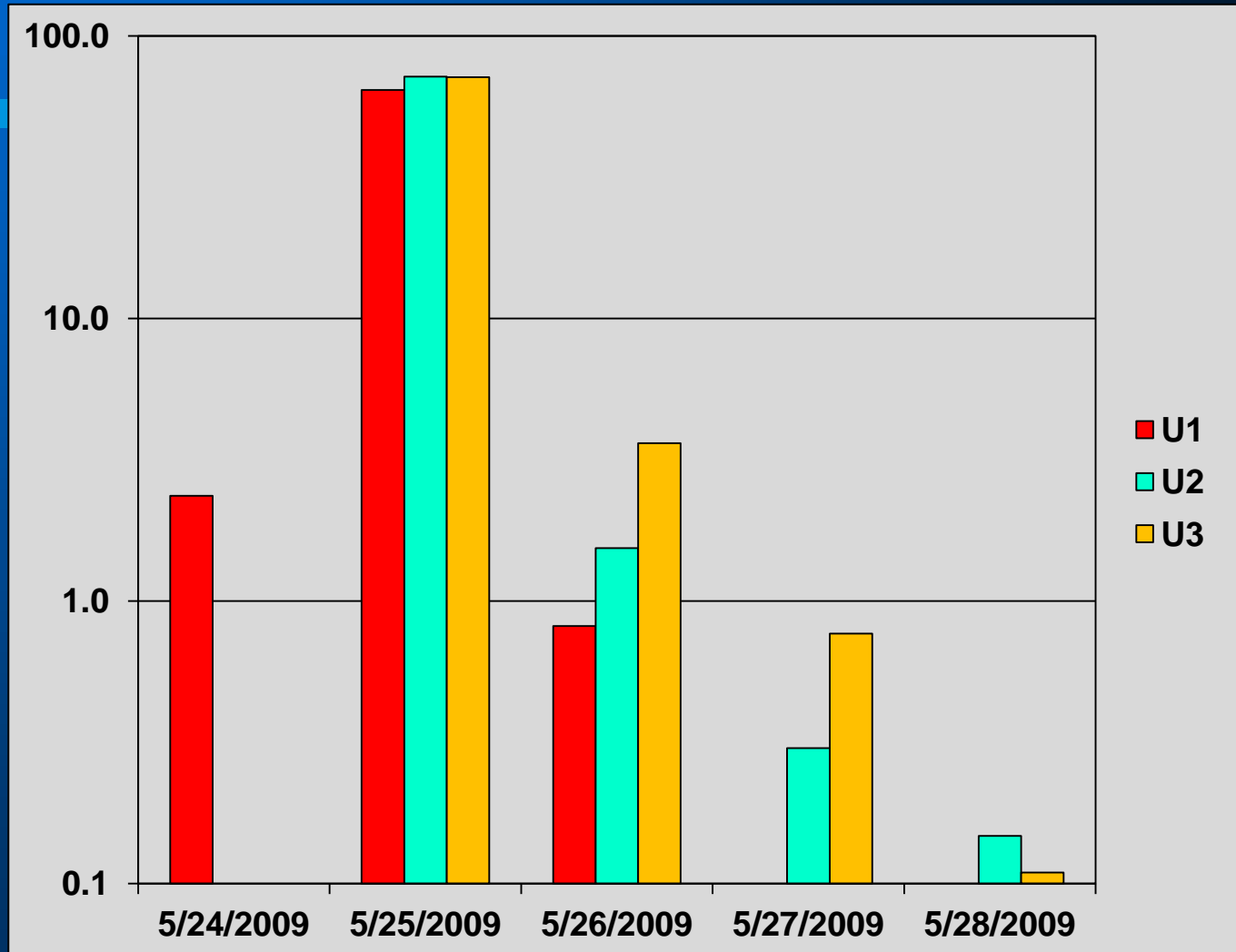
**Underwood 3 –
Samples from
May 25, 2009
Rain Event**

Underwood Sites 1, 2, & 3 May 25, 2009 Event

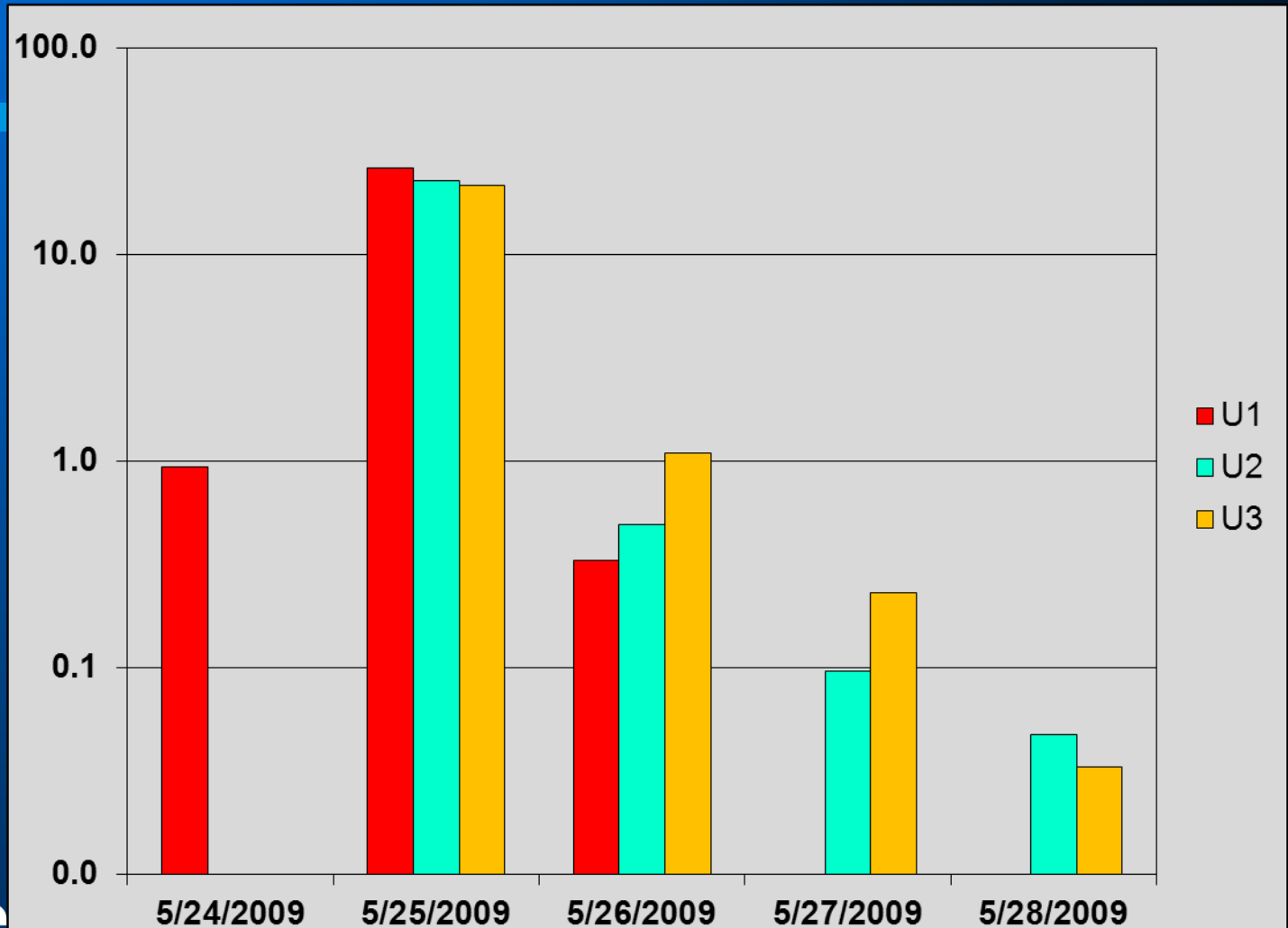
1.53 inches of rain



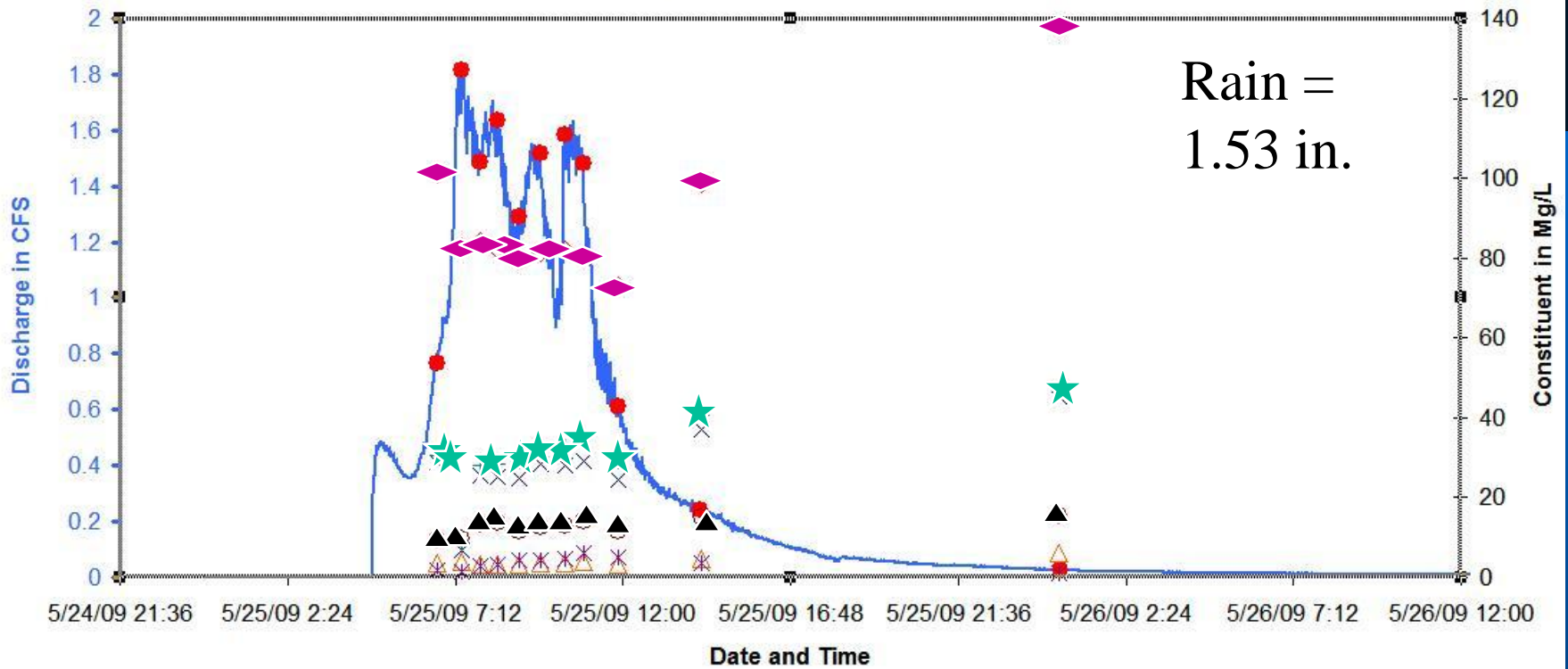
Total N Loads (in pounds)



Total P Loads (in pounds)



Underwood 1 QW Data May 25, 2009 Rain Event



- Discharge in CFS
- Sample Collected
- ◆ Chloride, water, filtered (@NDDH lab), mg/L
- △ Ammonia, water, unfiltered, mg/L as Nitrogen
- × Ammonia plus organic Nitrogen, water, unfiltered, mg/L
- * Nitrate plus Nitrite, water, unfiltered, mg/L
- ▲ Phosphorus, water, unfiltered, mg/L
- ★ Total Nitrogen (nitrate + nitrite + ammonia + organic-N), water, filtered, analytically determined, in mg/L

June 14, 2011 Rain Event

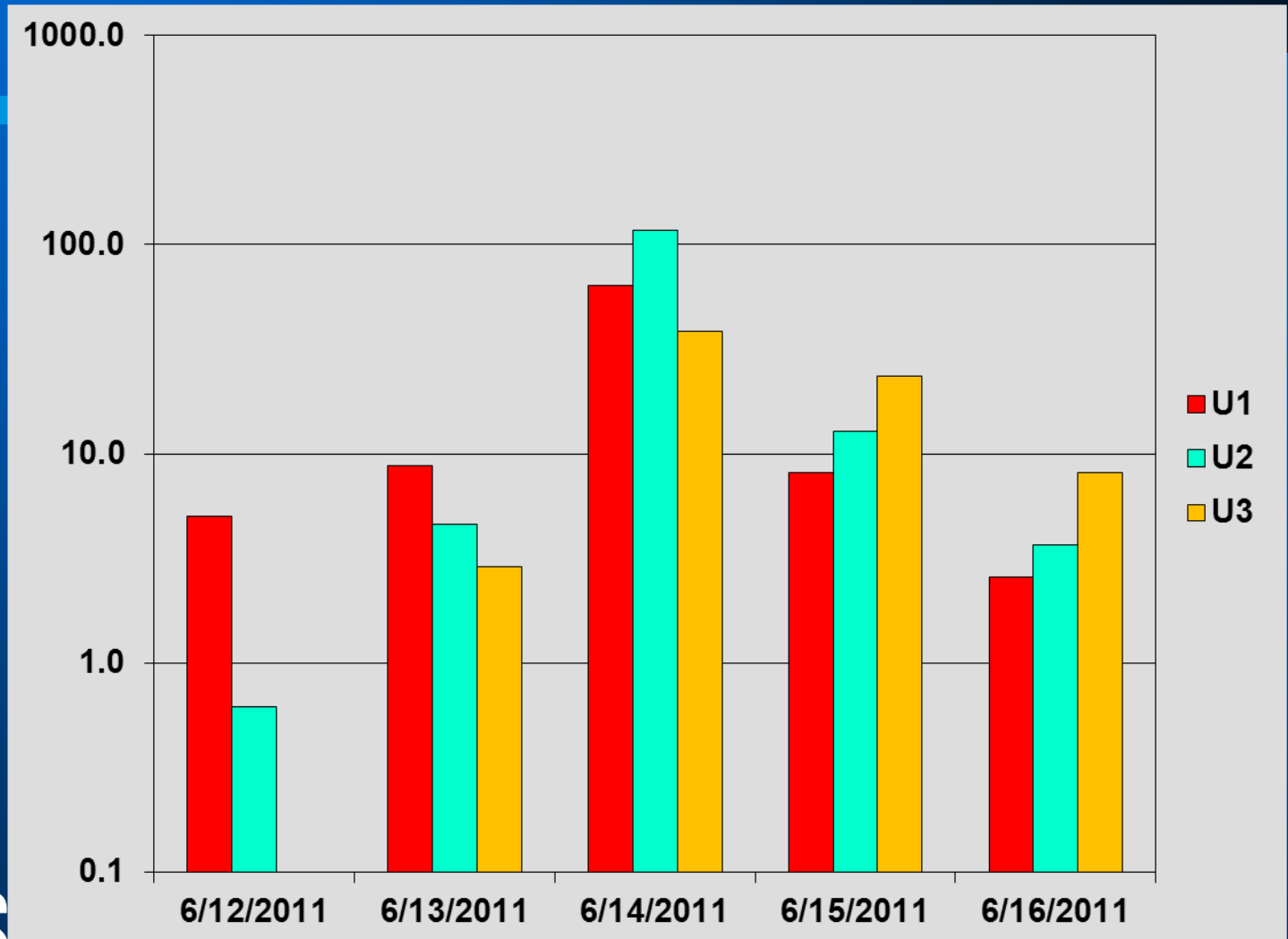


June 14 13:45 1.49 cfs

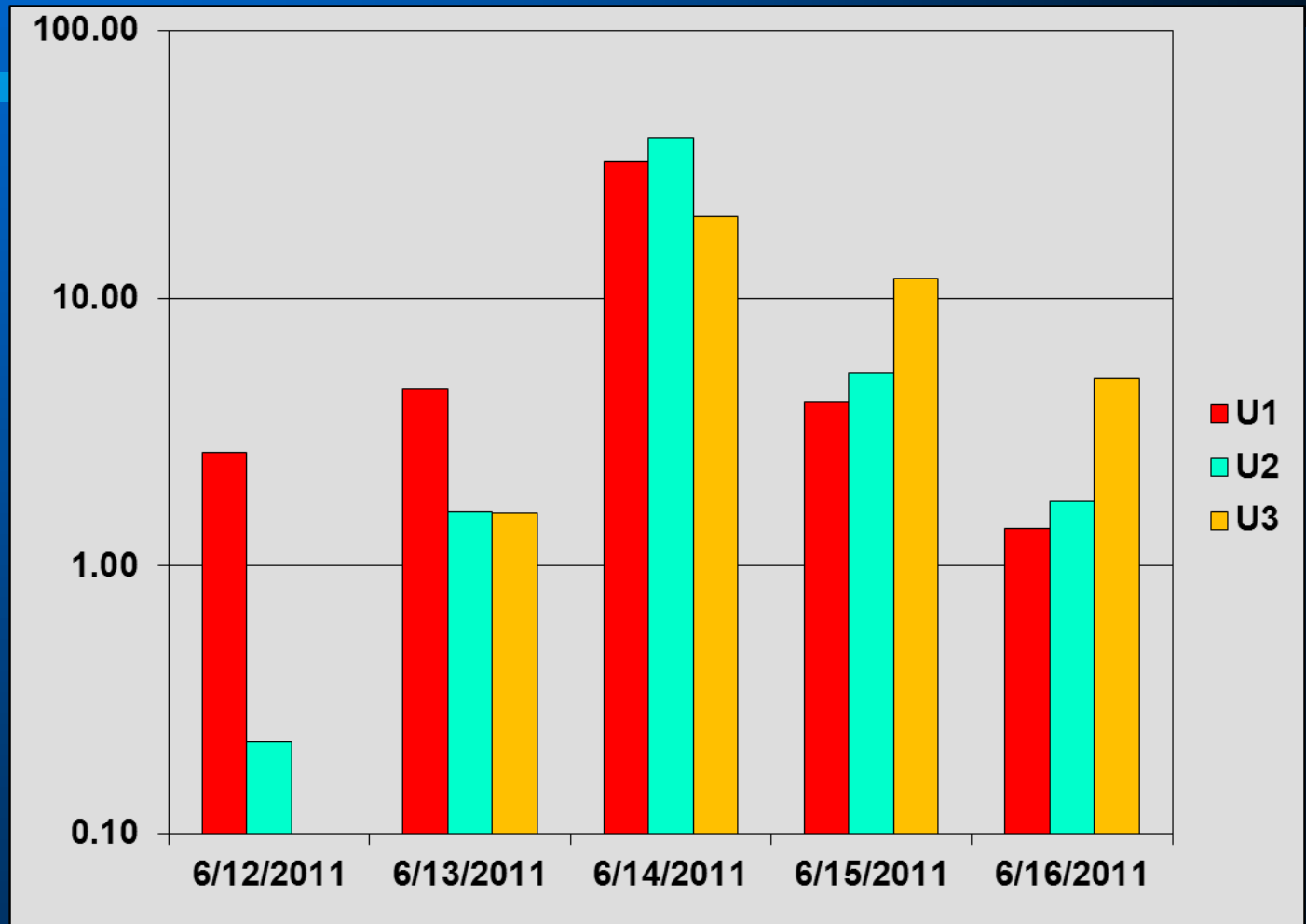




Total N Loads (in pounds)



Total P Loads (in pounds)



Embden

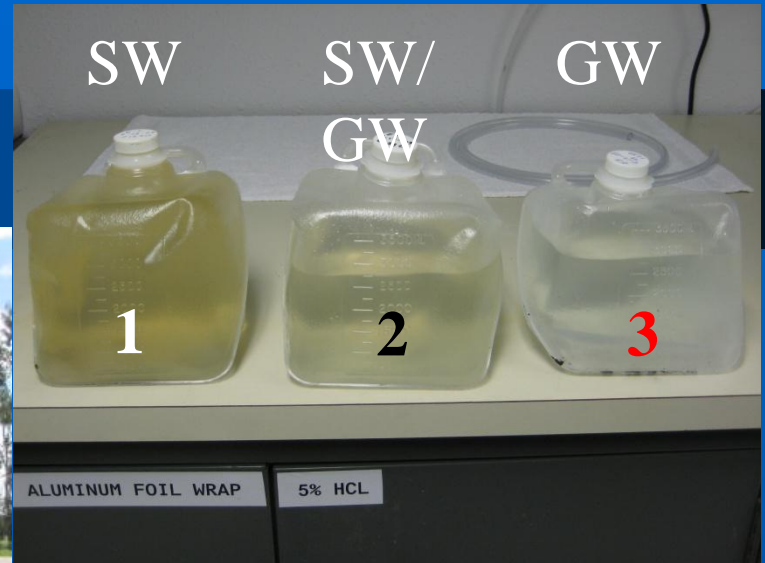
- Drainage area about .25 mi²
- Drains to Maple River (about .3 mi south)



Embden



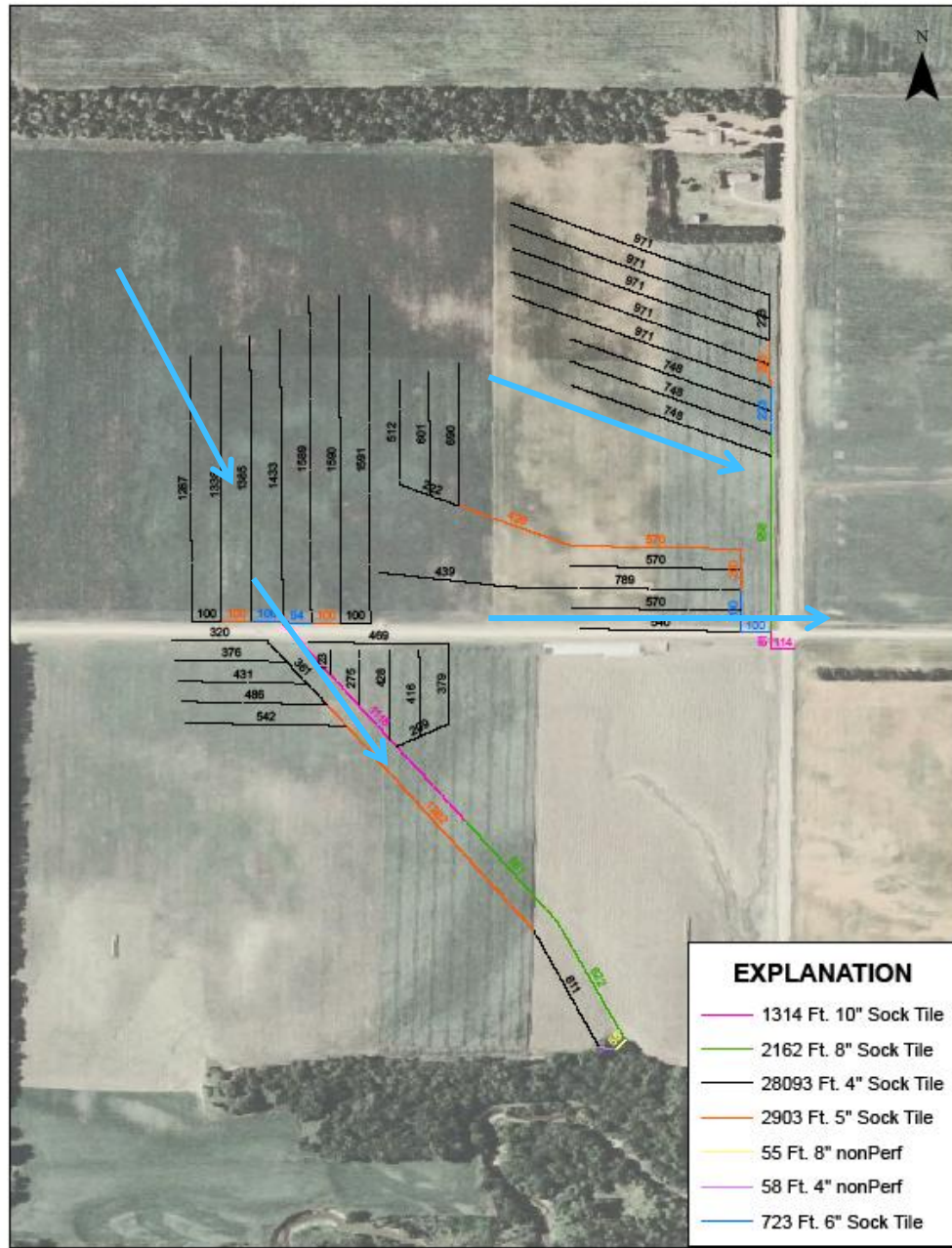
Embden 1 & 2



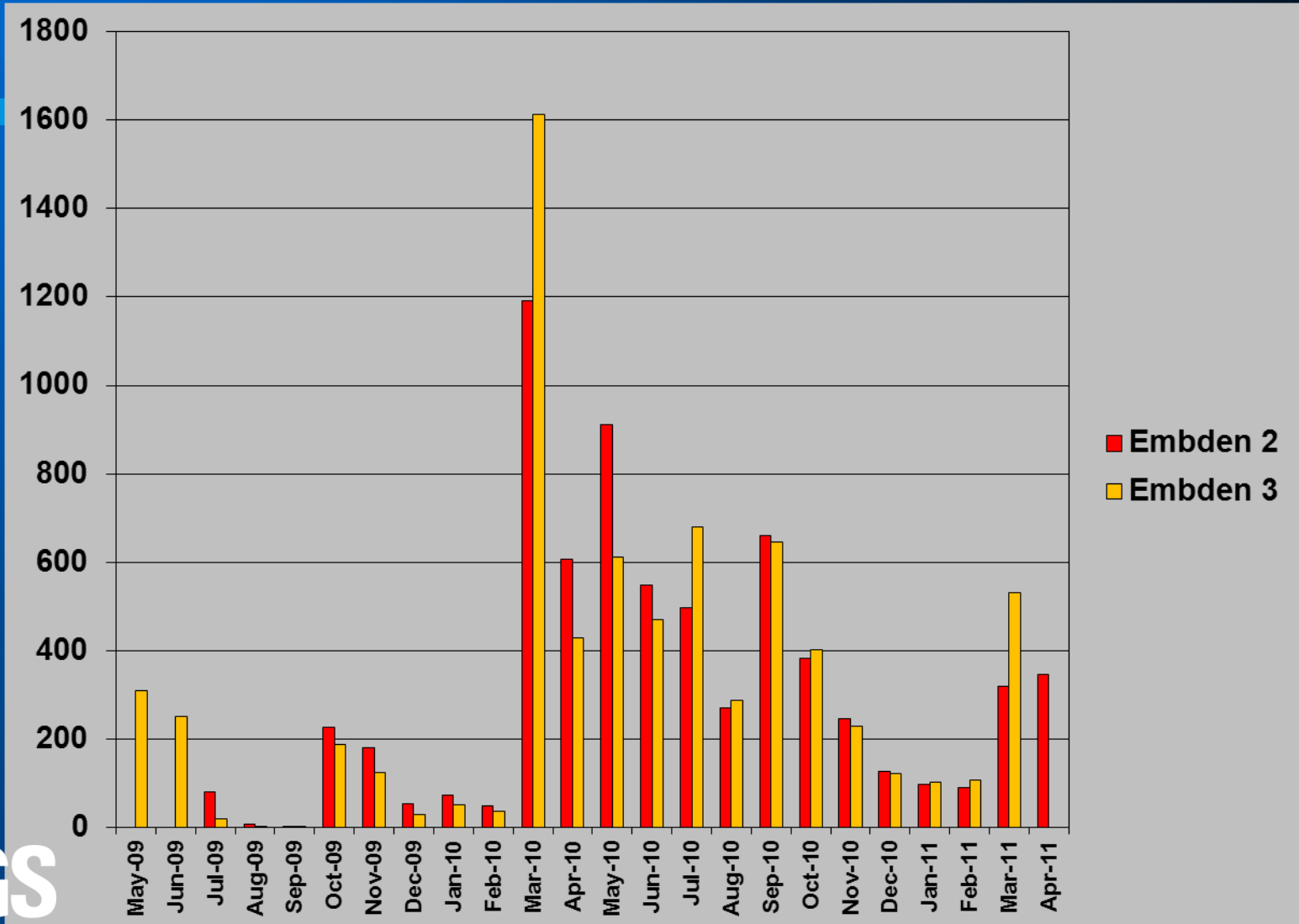
Embden 3



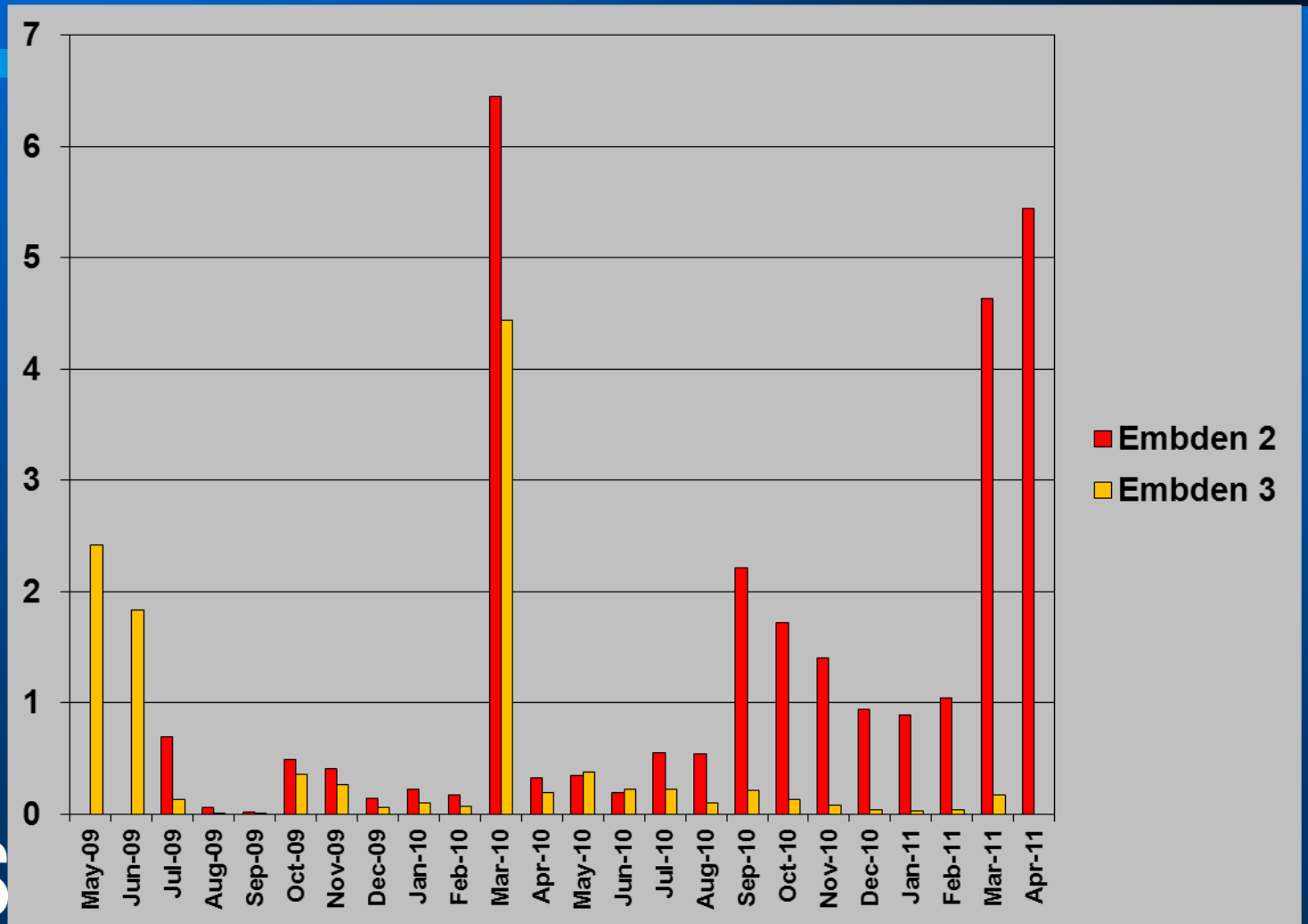
Location of drain tiles at Embden



Total N Loads (in pounds)



Total P Loads (in pounds)



Other studies at the farms...

- *Cryptosporadium* in small rodents – Dr. John McVey (NDSU Veterinary Department)
- Tracking hormone movement in soils from swine manure applications – F. Casey & T. DeSutter (NDSU Soils Department)
- Lidar mapping of small watersheds– Moffat Ngugi – N. G. P. Research Lab
- Marinus Otte (NDSU) Wetlands Study



“To be continued....”



“Getting the word out...”

North Dakota Discovery Farms On-Farm Edge of Feedlot and Tile Drainage Monitoring

Ron Wiederholt, North Dakota State University, Nutrient Management Specialist
Kathleen Rowland and Bill Damschen, U. S. Geological Survey

Abstract

North Dakota Discovery Farms have been operating since late 2007. The goals of the project are to collect real-time water quality data from operating farms while incorporating the knowledge and experience of the landowner in best management practice (BMP) development. As with any in-field farming project, the outcomes hinge on the collection of valid data. After working through equipment and weather-related logistics, monitoring data from 2009 and 2010 show some interesting results. Nitrate loads from feedlot runoff show a temporal pattern with the majority of the load being released during the spring snowmelt. Feedlot runoff nitrate load is also increased significantly during these events through vegetative treatment. The drainage monitoring has shown a significant load of nitrate exiting the drains in a similar temporal pattern. Farmer derived BMPs are being considered and some have been implemented to address the initial monitoring findings.

ND Discovery Farms Goals

- Encourage responsible livestock development while protecting our natural resources.
- Ensure a coordinated approach of regulatory practices and policies.
- Document and quantify environmental impacts of farming practices.
- Provide unbiased, reliable information on the relationship between agricultural production and natural resource management.
- Provide enhanced communication between farmers, researchers, educators, the general public and regulatory agencies.
- Establish a network of working farms to evaluate existing and innovative agricultural land use practices.
- Provide a platform for agricultural systems research.




Figure 1. Aerial photo of feedlot and field surface runoff monitoring stations at location 1 in Underwood, ND.

Sampling Protocol

- Sampling for nitrogen, phosphorous, chloride, total suspended solids, bacteria, conductance, and suspended sediment using ISCO automated samplers during snowmelt and rainstorm runoff events.
- Samples prepared by USGS North Dakota Water Science Center Lab and analyzed by the North Dakota Department of Health and USGS Iowa Sediment Lab.
- Also collecting stage (height of flow), discharge (amount of flow), air temperature, wind speed, wind direction, precipitation, relative humidity, soil moisture and temperatures at four depths.

Producer Response

Based on the outcomes of multiple year sampling, the producer at location 1 (Figure 1) is in the process of installing a clean water diversion around the feedlot to minimize snow melt from flowing through the feedlot area.

At location 2 (Figure 2), after learning of nitrate levels exiting tile drains, the producers have split the field in half and established perennial alfalfa over one tile drain system and will continue their annual cropping system (corn, wheat, soybeans) over the other tile system.

At both of these sites, monitoring will continue to determine the effectiveness of the producer's actions.

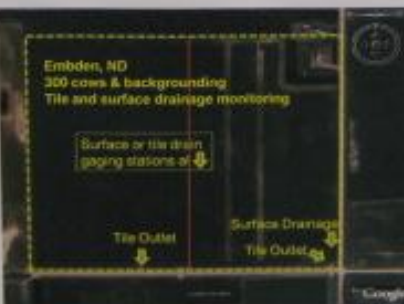
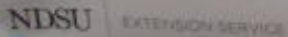



Figure 2. Aerial photo of field surface runoff and tile drainage monitoring stations at location 2, Embden, ND. Orange line depicts separation of the two separate tile systems draining the field.

Cooperators

- Kim and Denise Amann
- NDSU Extension Service
- Doyle and Patsy Johannes
- USGS ND WSC
- Kent and Sandy Bartholomay
- North Dakota Department of Health
- NDSU Agricultural Experiment Station
- North Dakota Water Science Center

2012/02/27 18:53

On the Internet

McLean County Farm Data

- ◆ [Current conditions](#)
- ◆ [NWIS](#)
- ◆ [Battery information](#)
- ◆ [Flags](#)
- ◆ [Hydrograph](#)

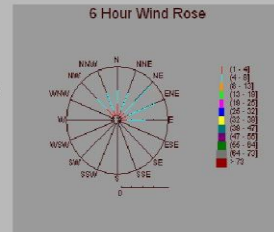
McLean County Farm



Current Conditions

Wednesday, September 10, 2008 7:27:29 PM

Air Temperature --	61.7 degrees F
Relative Humidity --	78.2%
Wind Speed --	3.5 MPH
Wind Direction --	354 Degrees from North
Total Rainfall Today --	0.00 Inches of Rain
Soil Moisture --	31.3% Saturation
Soil Temperature 2cm --	60.7 Degrees F
Soil Temperature 7cm --	59.3 Degrees F
Soil Temperature 12cm --	57.8 Degrees F



For more information...



<http://nd.water.usgs.gov/discoveryfarms>

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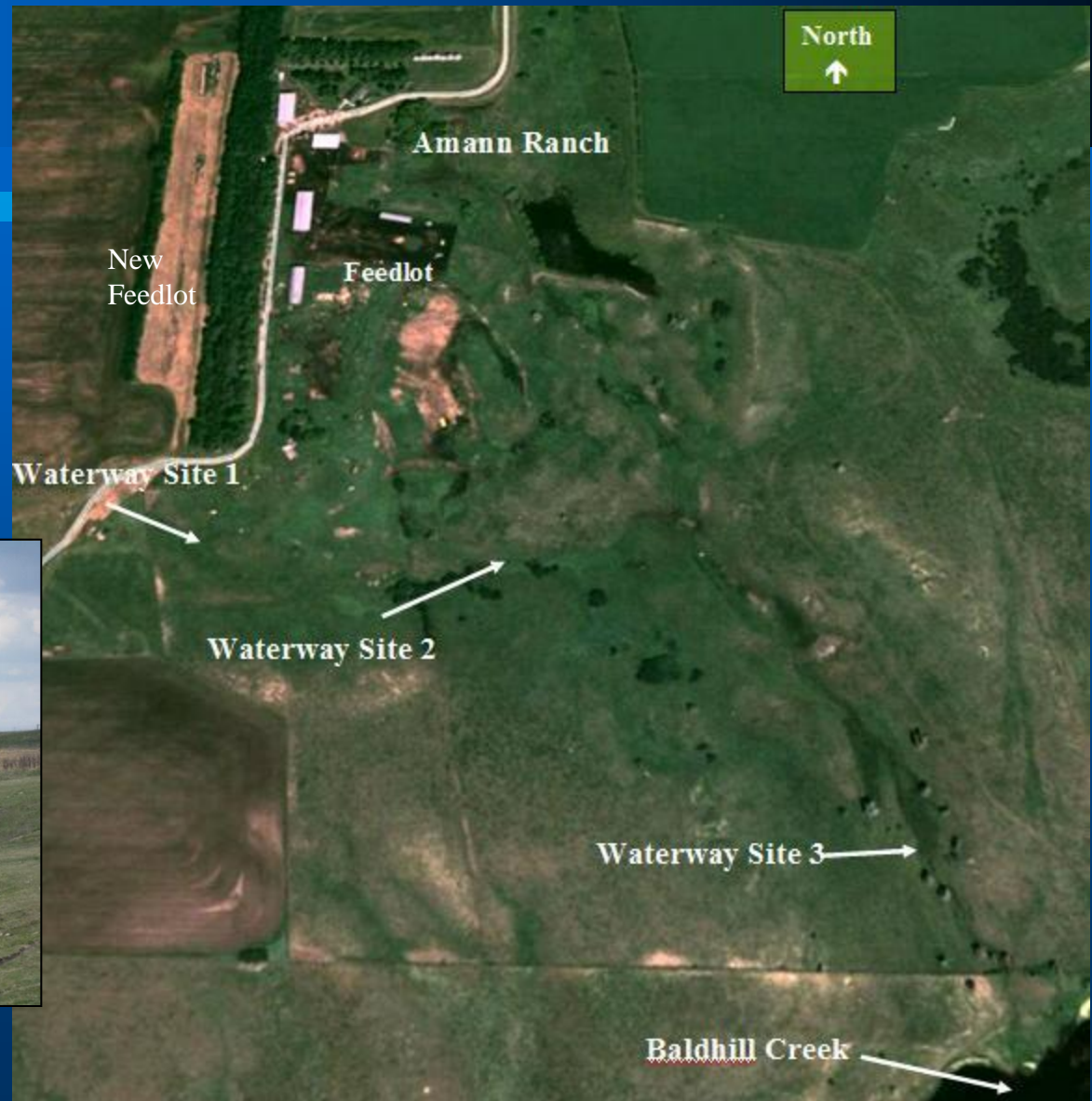


http://www.ndsu.edu/nm/north_dakota_discovery_farms/

Ron Wiederholt
(ron.wiederholt@ndsu.edu)

Dazey

- Drainage area about 1.5 mi²
- Drains to Sheyenne River (about 1 mi east)





Dazey



Ready to collect in 2009...



The calm before the
“storm”...Dazey #3 on
April 7, 2009



**During “spring
thaw” ...Dazey # 3 on
April 12, 2009**



**After “spring thaw”
...Dazey # 3 on April
14, 2009**



“We will build it better...”



“Bring it on...”

--Bill Damschen 2009